of epigenesis. A theory which has a formal answer for every question, which regards everything that we can see and lay hold of as predetermined and unalterable, which relegates the causes of phenomena to the unseen and unknowable—such a theory, if accepted as true, does not stimulate, but stifles inquiry. Fortunately it has had the opposite result. It has not been accepted, and it has developed an attack of a brilliant and overwhelming character. All the best arguments which Dr. Hertwig can bring against the theory of predetermination are derived, not from simple observation, but from experiment. A few simply conceived interferences with the normal course of the segmentation of the ovum have sufficed to strike down the doctrine of determinants. May we not hope that an extension of these methods may illuminate the regions which are still hidden from us? After all his attempts to supply an acceptable alternative to Weismann's scheme, Dr. O. Hertwig makes a partial confession of failure. To many his failure will seem complete, and it must be so since the evidence derived from experiment is as yet wholly inadequate. But his attempts indicate the paths along which research may be conducted, and he is very right when he claims, in conclusion, that it is the great merit of his conception of the developmental processes, that it opens the gates once more to research, with some brighter hope of results than the formal theory of predetermination afforded us.

G. C. BOURNE.

COAL-DUST AND COLLIERY EXPLOSIONS.

Coal-Dust an Explosive Agent, as shown by an Examination of the Camerton Explosion. By Donald M. D. Stuart. (London: Office of the *Colliery Manager*, and E. and F. N. Spon.)

IT is significant of the conservatism—not always wholly disinterested—that surrounds an old-established industry that, in spite of all that has been written and said on the action of coal-dust as an explosive agent during the last twenty years, we should still find people persistently clinging to the belief that the only possible cause of a colliery explosion *must* be fire-damp. It would be amusing, were the matter less serious, to note the extraordinary hypotheses and absurd surmises to which the believers in this time-honoured doctrine are occasionally driven in order to account for the existence of fire-damp in places where the common testimony of unbiassed people affords no proof of its presence. The hard logic of facts is, however, surely, even if slowly, undermining the mass of prejudice with which this question has been surrounded, and we may hope that before the close of the century the action of the Legislature will compel these people, whose obstinate unbelief jeopardises men's lives, to give practical heed, even more directly than at present, to the teachings of intelligent observation and inspection. The causes and conditions which lead to a colliery explosion are now so well understood that such a catastrophe ought to be no longer possible. If it does occur, we must lay the blame on the management and discipline of the mine, and it should not be difficult, under these circumstances, to fix the responsibility. The master of a vessel who carelessly navigates his ship, is liable to have his certificate dealt with in a very summary fashion. It does not avail him to plead that his crew are picked from a class that is proverbially reckless and foolhardy, and that his "look-out," therefore, was probably in fault. The Assessors take it for granted that he has a proper knowledge of his business, and they hold him responsible for the discipline on his vessel. Public opinion demands that a mine-manager should be treated in a similar manner. How difficult it is for the the law, in spite of the length of its arm, to get at a manager who has been guilty of culpable carelessness, has been shown in more than one inquiry that could be named.

As an illustration of the mental attitude to which we allude, we may refer to a recent report on the cause of the explosion at the Albion Colliery, South Wales, in June last. All the circumstances connected with that explosion seemed to indicate that it was due to the same cause as that which accounted for the explosions at the Park Slip, Apedale, and Malago Collieries, viz. the presence of coal-dust, and this conclusion was confirmed by the report of the inspectors appointed by the Home Office to inspect the colliery.

In a report prepared for the colliery proprietors by six engineers, we find that these gentlemen are unanimously of opinion that the disaster was caused by an outburst of fire-damp, and they have great satisfaction in stating that no blame in the matter can be attributed to any of the officials or employés. There is no wonder, in view of this conflict of testimony, that the men of the Rhondda district should have demanded a fresh inquiry by the Government into the cause of the disaster.

The changes of opinion among "practical" men on this question of coal-dust are very suggestive, and strikingly exemplify the course through which a new truth has to run when it is in conflict with the settled conviction of interested persons. Like the course of true love, it does not run at all smooth under these circumstances. The idea that coal-dust could be the cause of a colliery explosion was, in the outset, scouted as absurd. Then, as facts multiplied, the dust was allowed to have a share in the catastrophe: it aggravated the violence of a fire-damp explosion. Next, the proportion of the fire-damp became smaller by degrees, until it reached the vanishing-point. Now we have reached the stage that all dusts are not explosive, and the colliery manager is satisfied that his dust is not as other men's dust. Even in the case of those who were more receptive of the teaching of experiment and of trained observation, the recognition of the real facts has had to run the conventional course. First they were not true, then they were not new, and we knew of them before; for did not Faraday and Lyell tell us all about the matter in the Haswell report? In a question of this kind, colliery management ought to be in advance of public opinion. That it has not always been so in the past, the history of coal-mining shows only too plainly. It was the shock to public sentiment, caused by a succession of disastrous explosions, which occurred in the early part of this century, that indirectly brought about a revolution in the art of coal-getting. People in the colliery districts, who were witnesses of the terrible loss

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of human life, and of the misery and destitution that followed it, asked their fellows if this ought to be part of the price to be paid for coal, and the answer was given in no uncertain tones. Government inspection was insisted upon, and, in spite of persistent opposition, eventually obtained. In the outset, the character of the inspection was not always what it should be; but, little by little, this has improved. We have a better trained class of men sent out by the Home Office now than formerly, and their hands have been gradually strengthened by the Legislature, although, perhaps, not to the extent that is desirable.

Statistics show that this intelligent inspection is gradually making its influence felt. Tested by the ratio of fatalities to number of men employed, and to amount of material raised, there is a slow but decided improvement. Of course, even under the most ideal system of inspection, coal-mining will continue to be a hazardous occupation; but this at least we may hope, that the steady sacrifice of 1000 victims a year, which that ruthless potentate, Old King Coal, seems to demand, shall not continue to be augmented by catastrophes that ought to be considered as preventable.

Mr. Stuart's book is to be welcomed, therefore, as adding one more link to the chain of evidence which establishes the fact that coal-dust may be the most important and, at times, even the only agent in bringing about a colliery explosion. About a year ago an explosion occurred at the Camerton Collieries in Somersetshire, the significant feature of which was that it took place in a mine wholly free from fire-damp. All the circumstances connected with this explosion were brought to the knowledge of Mr. Chamberlain's Commission by Mr. Garthwaite, the general manager, and were fully inquired into by H.M.'s inspectors. Mr. Stuart's examination was made independently of the official investigation, and it is satisfactory to note that as regards the main conclusion there is absolute unanimity on all sides. There can be no possible doubt, therefore, that the explosion of November 14, 1893, at the New Collieries, Camerton Court, was due to coal-dust, and to coal-dust alone, initiated by a gunpowder shot, and most probably by what is technically known as a "blown-out shot." Mr. Stuart's examination showed that there were no "extraordinary circumstances" present; the shot-firing was an ordinary operation, the presence of coal-dust was a normal circumstance, and the work was being done by a competent man. "The angle and declivity of the hole were such, that if the gunpowder were expelled, it would directly strike the dust; but it was so placed in the judgment of an experienced miner. . . . In the presence of this explosion, therefore, conjecture upon the supposed innocuousness of a gunpowder shot in a dry and dusty non-gaseous mine is at an end."

Whilst we wholly agree with Mr. Stuart in this conclusion, we are not altogether at one with him in regard to his explanation of the chemical process of a coal-dust explosion. Mr. Stuart appears to be of opinion that a coal-dust explosion is in reality only another form of a gas explosion. The action of the heated products of the exploded gunpowder is, he assumes, to cause the dust to experience a kind of destructive distillation whereby hydrogen and gaseous hydrocarbons are formed, which at the high temperature combine explosively with the oxygen of the air of the mine. Whether there is any necessity to invoke this distillatory process as an explanation of the phenomena, is extremely doubtful. Without expressing any final opinion on this point, it may be pointed out that no definite relation between the bituminous character of the dust and its "sensitiveness" as an explosive agent has been established. The dry mines of South Wales, where some of the most formidable explosions of recent times have occurred, yield a dust which is relatively rich in carbon, and which affords no very large quantity of gas on distillation.

We would commend this book to the thoughtful attention of every colliery manager, with, however, the reservation that Mr. Stuart's theories are not to be accepted as of the same value as his facts. So long as he confines himself to the orderly arrangement and analysis of these facts he is on perfectly safe ground. The weakest portion of the book is that in which the author seeks to elucidate the chemical and physical phenomena of a coal-dust explosion, by the application of imperfect thermal data and of irrelevant chemical observations.

THE MODE OF LIFE OF MARINE ANIMALS.

Die Lebensweise der Meeresthiere. Beobachtungen über das Leben der geologischwichtigen Thiere. Von Johannes Walther. Zweiter Theil einer Einleitung in die Geologie als historische Wissenschaft. (Jena: Gustav Fischer, 1893.)

THIS is the second part of Prof. Walther's projected extensive geological treatise, the first part of which—on the Bionomy of the Sea—appeared some time ago. Of the three titles given, the second, or subsidiary one, seems best to describe the scope of the present book. It is not, as might be supposed from the primary title, a treatise on the physiology of marine animals—would that it were! that is still a great desideratum in biology—but is rather some observations on certain points in the life-relations, or mode of occurrence, of certain marine animals, viz. those which are of importance to the geologist [and no less to the biologist] as being the present-day representatives of former animals now preserved as fossils. Walther's idea is that we must study the relations of organisms to their environment at the present day, before drawing deductions from fossil remains as to the physical conditions of past geological periods. His object is to lay a sound foundation of fact, as to the mode of occurrence of particular sets of animals, upon which to base an account of the history or development of the events chronicled in the rocks. The idea is a sound enough one, if not very original—it must surely have been present, consciously or not, in the minds of various geological and biological writers—and the conclusions arrived at, if really based upon a sufficiently large accumulation of statistics, will no doubt be a valuable guide to the geologist in forming his opinions. The book, if very complete in its series of facts, would also be a useful reference work to the zoologist; but it may be doubted, on an examination of the lists given by

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